rate errors, system robustness, and the characteristics of the system. However, these tests are not sufficient to determine system performance and must be supplemented by **subjective assessment** during the ATTC laboratory tests **by an expert panel.** The Committee, therefore, added to the attributes list in section II," **3.14 Subjective Assessment by an expert panel.**"

In response to a report that SS/WP4 Task Force on Priorities had raised the question of defining a minimum audio service, the members agreed that there should be no change to the present statement that the minimum service is that provided within current NTSC practices namely a stereo audio pair and a SAP channel.

The members did agree to add to the list under II, 3.11, Audio Security, a request for information about any scrambling techniques, as section **3.11.4 Scrambling Techniques.** The current section 3.11.4 would be renumbered as section 3.11.5.

The members considered the question of adding an attribute concerning response to "sudden cuts" and concluded that sections 3.9.4.7, 3.10.4.7, and 3.11.5.6 - "Any other artifacts" covered this item.

It was reported that SS/WP2 had decided that a dynamic zone plate test signal should be used to test dynamic resolution. The members concluded that the current attributes list sufficiently covers this item but noted that during objective testing there should be qualitative assessment of the effect on the image, as well as, quantitative assessment.

The members agreed that for the purpose of testing compatible systems, FCC Regulations, Part 73 should be applied as appropriate.

The members further agreed that Working Parties 1 and 2 should provided input to the Chair of SS/WP2 Task Force on Field Testing on the concerns the members have on that issue. The members agreed that there is a consensus within WP1&2 that while laboratory testing will produce much information on the performance characteristics of a system, that issues of multiple path and ATV/ATV interferences can only be tested in the field.

After discussion and consideration of the system testing requirements, the members reached consensus that a signal source of high spectral and temporal quality having no lag and exhibiting high quality MTF should be employed and that the Showscan system could provide such a source. The members recommended the use of 10 seconds, minimum of a such a source to provide a means of demonstrating growth potential and possibility of system adeptness to handle future high definition sources.

The members agreed that in the testing of any proponent system, sample IDTV receivers of the latest type should be included in the tests. The attributes list for Section II, 8. Consumer Equipment Issues was modified to include **8.3.4 IDTV Receiver Compatibility.** IDTV and standard NTSC receivers should be observed for performance with and without

line and/or frame comb filtering.

The members discussed what was meant by the term "enhancement" and agreed that adjusting camera response to being essentially flat is not considered enhancement. The members agreed that "non-enhanced" materials should be used and that all materials should be "normalized". Normalization means that camera generated images should be made to match as closely as possible electronically generated images within the bandwidth limitations of the system and that adjustments to camera generated images should not produce overshoots of over 5% with a goal of a maximum of 2% being urged. Further, no images should be used for testing which have been noise cored.

In response to item 7) the members stated: "We recognize the difficulty of obtaining the MTF curves requested in attribute 2.2 without obtaining internal signals from proponent equipment. Because of the importance of this attribute, indirect methods may be employed to quantify chroma response." It was pointed out that the value to be measured is for the smallest object that can be reproduced in color.

Attribute **6.4 Susceptibility to Interference** was modified by adding the phrase **"on picture and sound."**

After discussion of item 8), the members agreed to modify the attributes list section **1.4 Artifacts** and to add the following:

> **1.4.1 The performance of ATV systems which have been spatially or temporally prefiltered including the use of motion detection.**
>
> **1.4.2 The performance of ATV systems in response to input signals having random noise, clock noise, etc. superimposed on them.**

Some members present raised concerns about the ability of the ATTC to test these attributes considering costs and time involved. The Working Party decided that it was inappropriate for it to make a decision on this question, that the decision belonged elsewhere.

There was a discussion on the appropriateness of Washington as the field test site and on the need to have more than one such test site. There was consensus to add two more attributes to the list in **Section 6.9 Transmission Field Testing** as follows:

> **6.9.1 At least one (1) location exhibiting average amount of difficulty, and**
>
> **6.9.2 At least one (1) location considered "difficult".**

It was reported that the field tests were designed to obtain data on system performance in response to multi-path delays, airplane flutter, weather conditions, and the like. The testing will also be directed to the UHF band. There are currently no plans to test in the low-band VHF spectrum. The broadcasters present believed that performance testing in both bands was an important issue.

Renville H. McMann
963 Oenoke Ridge
New Canaan, CT 06840

PSWP1 & WP2-080

TO: J. Flaherty, Chairman - Planning Subcommittee (PS)
FM: R. McMann, Chairman - PS Working Party 1 (PS/WP1)
DT: 30 November 1990
RE: Chairman's Report for ACATS Interim Report #4 from PS/WP1 and PS/WP2.

PS/WP1 (Working Party on ATS Technology Attributes and Assessments) and PS/WP2 (Working Party on ATS Testing and Evaluation Specification) were reconvened at the request of the Planning Subcommittee Chairman.

You should note that this report covers the activities of both PS/WP1 and PS/WP2, as the two committees met jointly throughout this reporting period.

PS/WP1 and PS/WP2 were reconvened to address the following:

1) the need to supplement the testing of audio channels in the digital domain and objective testing of audio channels in the analog domain by subjective assessment;

2) testing of image dynamic resolution;

3) testing of compatible systems;

4) use of Show-scan material;

5) test method for EDTV into IDTV receivers;

6) use of pre-enhanced material for testing;

7) consider deleting the chroma resolution requirement in Section 6.2; and

8) source signal processing.

Meetings were held on 29 May, 6 July and 8 October 1990. Minutes of the meetings along with supporting documents are attached.

During the meeting of 29 May 1990, the Committee agreed to, henceforth, meet jointly and work in concert. The Committee also addressed items 1) through 6) above.

After a short discussion, the members agreed that testing of the audio channels in the digital

domain and objective testing in the analog domain provides important and useful information about bit rate errors, system robustness, and the characteristics of the system. However, these tests are not sufficient to determine system performance and must be supplemented by **subjective assessment** during the ATTC laboratory tests **by an expert panel.** The Committee, therefore, added to the attributes list in section II," **3.14 Subjective Assessment by an expert panel."**

In response to a report that SS/WP4 Task Force on Priorities had raised the question of defining a minimum audio service, the members agreed that there should be no change to the present statement that the minimum service is that provided within current NTSC practices namely a stereo audio pair and a SAP channel.

The members did agree to add to the list under II, 3.11, Audio Security, a request for information about any scrambling techniques, as section **3.11.4 Scrambling Techniques.** The current section 3.11.4 would be renumbered as section 3.11.5.

The members considered the question of adding an attribute concerning response to "sudden cuts" and concluded that sections 3.9.4.7, 3.10.4.7, and 3.11.5.6 - "Any other artifacts" covered this item.

It was reported that SS/WP2 had decided that a dynamic zone plate test signal should be used to test dynamic resolution. The members concluded that the current attributes list sufficiently covers this item but noted that during objective testing there should be qualitative assessment of the effect on the image, as well as, quantitative assessment.

The members agreed that for the purpose of testing compatible systems, FCC Regulations, Part 73 should be applied as appropriate.

The members further agreed that Working Parties 1 and 2 should provided input to the Chair of SS/WP2 Task Force on Field Testing on the concerns the members have on that issue. The members agreed that there is a consensus within WP1&2 that while laboratory testing will produce much information on the performance characteristics of a system, that issues of multiple path and ATV/ATV interferences can only be tested in the field.

After discussion and consideration of the system testing requirements, the members reached consensus that a signal source of high spectral and temporal quality having no lag and exhibiting high quality MTF should be employed and that the Showscan system could provide such a source. The members recommended the use of 10 seconds, minimum of a such a source to provide a means of demonstrating growth potential and possibility of system adeptness to handle future high definition sources.

The members agreed that in the testing of any proponent system, sample IDTV receivers of the latest type should be included in the tests. The attributes list for Section II, 8. Consumer Equipment Issues was modified to include **8.3.4 IDTV Receiver Compatibility.**

IDTV and standard NTSC receivers should be observed for performance with and without line and/or frame comb filtering.

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During the meeting of 6 July 1990, the Committee addressed item 7) above.

In response to item 7) the members stated: "We recognize the difficulty of obtaining the MTF curves requested in attribute 2.2 without obtaining internal signals from proponent equipment. Because of the importance of this attribute, indirect methods may be employed to quantify chroma response." It was pointed out that the value to be measured is for the smallest object that can be reproduced in color.

Attribute **6.4 Susceptibility to Interference** was modified by adding the phrase **"on picture and sound."**

During the meeting of 8 October 1990, the Committee addressed item 8) above.

After discussion of item 8), the members agreed to modify the attributes list section **1.4 Artifacts** and to add the following:

> **1.4.1 The performance of ATV systems which have been spatially or temporally prefiltered including the use of motion detection.**
>
> **1.4.2 The performance of ATV systems in response to input signals having random noise, clock noise, etc. superimposed on them.**

Some members present raised concerns about the ability of the ATTC to test these attributes considering costs and time involved. The Working Party decided that it was inappropriate for it to make a decision on this question, that the decision belonged elsewhere.

There was a discussion on the appropriateness of Washington as the field test site and on the need to have more than one such test site. There was consensus to add two more attributes to the list in **Section 6.9 Transmission Field Testing** as follows:

6.9.1 At least one (1) location exhibiting average amount of difficulty, and

6.9.2 At least one (1) location considered "difficult".

J.Kean was assigned the task of liaising with ATTC to provide specific descriptions on how each of the attributes would be tested.

It was reported that the field tests were designed to obtain data on system performance in response to multi-path delays, airplane flutter, weather conditions, and the like. The testing will also be directed to the UHF band. There are currently no plans to test in the low-band VHF spectrum. The broadcasters present believed that performance testing in both bands was an important issue.

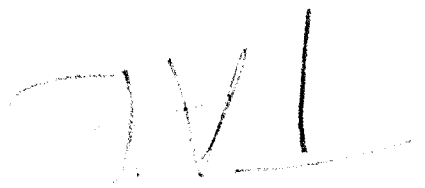
PS/WP1&WP2-081

29 Nov 90

FCC ADVISORY COMMITTEE ON ADVANCED TELEVISION SERVICE [ATS]
PLANNING SUBCOMMITTEE
WORKING PARTY 1 [PS/WP1]
ON ATS TECHNOLOGY ATTRIBUTES AND ASSESSMENTS
AND WORKING PARTY 2 [PS/WP1]
ON ATS TEST PLANNING

List of Participants

Ren McMann, Chairman PS/WP1
Stan Baron, Vice-Chairman PS/WP1
Max Berry
Joseph Flaherty, Chairman, PS
Hugo Gaggioni
Jim Gaspar
Alan Godber
Charles Heuer
Bronwyn Jones
Jack Kean
Tom Keller, Vice-Chairman PS/WP1
Jeff Krauss
Bob McFarlane
Irv Rosner
Greg Thagard
Christopher Tobin
Victor Towil
Tony Uyttendaele
Tom Watson



PS/WP-3-

FOURTH INTERIM REPORT OF THE SPECTRUM UTILIZATION AND ALTERNATIVES WORKING PARTY of the PLANNING SUBCOMMITTEE of the ADVISORY COMMITTEE ON ADVANCED TELEVISION SERVICE

March 7, 1991

TABLE OF CONTENTS

I. EXECUTIVE SUMMARY

This document constitutes the Fourth Interim Report of the Spectrum Utilization and Alternatives Working Party (Working Party 3) of the Planning Subcommittee of the Federal Communications Commission's Advisory Committee on Advanced Television Service. As described in more detail in its three earlier reports, Working Party 3 (PS/WP-3) was given primary responsibility of providing the Planning Subcommittee and, ultimately via the Advisory Committee, the FCC with advice concerning spectrum utilization and alternatives as related to the Advanced Television Service (ATS). During this reporting period, four of PS/WP-3's specialist groups made major progress in their assigned work.

Specialist Group 3, which deals with issues surrounding broadcast support spectrum, made progress in four principal areas. First, it identified a number of critical issues associated with the need for additional non-broadcast spectrum to support the deployment of a terrestrial ATV broadcast service. One particularly significant issue that it identified was the importance of the definition of "simulcasting." This definition will have a profound effect on the requirements of non-broadcast support spectrum. A clear understanding is needed before concrete plans are established. Second, the specialist group initiated a letter to the ATV proponents to solicit their comments regarding the possible impact of their proposed systems on contribution and distribution systems used by the television broadcast community. Third, the specialist group undertook a study of the impact of ATV broadcast support spectrum in the State of North Carolina. North Carolina was chosen in order to gather information of the possible impact in smaller markets. The study concluded that, while each broadcaster in North Carolina could be provided with an additional STL channel to carry the ATV signal, it would probably require the installation of higher performance (e.g., more directive) antennas. Fourth, and finally, Specialist Group 3 reviewed possible new spectrum for ATV broadcast support services.

During the next reporting period, Specialist Group 3 will (a) analyze the responses received from the proponents regarding carriage of their particular ATV signals on microwave and other types of contribution and distribution circuits, (b) based on this analysis, survey existing manufacturers of contribution and distribution equipment regarding issues associated with the transmission of ATV signals on their systems, and (c) continue to further narrow the set of recommendations in the area for which it is responsible.

Specialist Groups 6 and 7, which deal with spectrum analysis and taboos, respectively, continued their efforts to analyze the broadcast spectrum requirements for ATV systems. Considerable progress was made toward the ultimate objective of determining spectrum availability, including taking into

account the impact of the potential taboos. Using computer resources provided under the auspices of the Broadcast Caucus, studies were undertaken of ATV accommodation statistics taking into account taboos under various scenarios. The first scenario applied the taboo restrictions to all ATV and NTSC assignments, the second scenario applied the taboo restrictions only to existing NTSC assignments, while the third scenario also applied the taboo restrictions to existing NTSC assignments, but allowed collocation or near collocation of the taboo channel. Four preliminary findings resulted from this on-going work: First, regardless of which scenario was examined, the adjacent channel taboo was determined to achieve the worst accommodation statistics for ATV, while the IM-related taboos exhibited the best statistics. Second, the NTSC/Co-located Scenario was determined to achieve the best accommodation statistics. Third, except for the picture image taboo, the effect of increasing or reducing taboo separation distance has little or no impact on the ATV accommodation statistics. Fourth, allowing exact collocation of the taboo channel slightly/moderately improves the accommodation statistics of ATV. Near collocation of the taboo channel adds little, if any, improvements to the accommodation statistics.

Second, there were considerable discussions within the Working Party on whether PS/WP-3 is ultimately tasked with recommending specific ATV channel assignments to existing licensees. While such data will be available, there seems to be no clear consensus on how to proceed. The Working Party will continue to address this issue during the next working period, and may seek further guidance from the Advisory Committee on this issue.

In addition, during the next reporting period, Specialist Groups 6 and 7 will complete their currently on-going studies regarding the impact of "taboos" on ATV spectrum availability. These specialist groups will also continue their efforts regarding the possible development of the computerized service area and interference model for evaluating and comparing ATV transmission systems. Following the work just described, further efforts by these two specialist groups will, by and large, have to wait on the results of the tests of the proponent ATV systems by the ATTC.

Specialist Group 10, which deals with the development of the planning factors necessary to determine the basic service areas of the new ATV service, continued its work during the reporting period. Utilizing the planning factors used in the NTSC Channel Allotment Plan as a point of departure, the specialist group began the process of identifying and modifying the factors to take into account the new information associated with ATV systems/channels. Specialist Group 10 also provided support to the Working Party in responding to a request from SS/WP-4 regarding how to judge

the spectrum related aspects of particular ATV systems. SS/WP-4 adopted PS/WP-3's criteria in this respect.

The specialist group worked with SS/WP-2 in determining how to use the ATV system's test results. First, the specialist groups recognized that a computer program allowing the rapid preparation of graphical representations of interference-free service areas under a variety of geographic spacing and power/antenna height combinations would be desirable for future studies. Zenith Electronics Corporation has developed a program for this purpose and offered its cooperation to this end. The specialist groups and the Working Party are currently exploring alternatives for acquiring and validating such a capability, and have invited the active participation of other proponents in this effort.

In the next reporting period, Specialist Group 10 anticipates acquiring information from the manufacturers of television receiving antennas regarding the technical characteristics of their products. This specialist group will also continue to consider the proper definition of coverage areas for ATV systems while paying particular attention to the special characteristics of digital transmissions systems.

Specialist Group 4, dealing with the possibility of accommodating ATV systems in the spectrum above 1 GHz, and Specialist Group 9, dealing with cross-border allotment issues, were essentially dormant this reporting period, although attention of the specialist groups was drawn to Mexico's 12 GHz propagation tests. During the next reporting period, Specialist Group 9 will reinforce its efforts to re-establish contacts and a constructive working relationship with appropriate Canadian representatives, and to establish initial contacts with appropriate Mexican officials.

II. BACKGROUND AND INTRODUCTION

This document constitutes the Fourth Interim Report of the Spectrum Utilization and Alternatives Working Party (Working Party 3) of the Planning Subcommittee of the Federal Communications Commission's Advisory Committee on Advanced Television Service. As described in more detail in its three earlier reports, Working Party 3 (PS/WP-3) was given primary responsibility of providing the Planning Subcommittee and, ultimately via the Advisory Committee, the FCC with advice

concerning spectrum utilization and alternatives as related to the Advanced Television Service (ATS). The meetings of the Working Party continued to be well attended during the reporting period. Attendance by name and affiliation is summarized in Appendices D and E, respectively.

Also, as previously reported, PS/WP-3 initially divided its work into three fundamental parts. The first part was to deal with various alternatives for accommodating an Advanced Television (ATV) system within existing VHF and/or UHF television allocations. This part of the work was subsequently expanded to include consideration of United States - Canada and United States - Mexico cross-border allotment issues. The second part of PS/WP-3's effort was to deal with the issues surrounding the alternative of accommodating ATV in the region of the spectrum above 1 GHz. The third and final part dealt with the possible impact of ATS on the spectrum utilization of various broadcast support and non-broadcast services.

Again, as previously reported, PS/WP-3 organized itself into specialist groups in order to more effectively carry out its work in each of the three areas noted above. During the current reporting period, Specialist Group 3 continued its work analyzing the impact of ATV on broadcast support services and non-broadcast spectrum, and the results of their efforts are described in Section III. The work of Specialist Group 4 relating to accommodating ATV in the spectrum above 1 GHz has, for the most part, been deferred for

reasons briefly described in Section IV. Also during the reporting period, Specialist Group 6 on Spectrum Analysis and Specialist Group 7 on Taboos continued to work in tandem since the principal effort to analyze spectrum requirements for ATV systems is now focused on the critical issues surrounding the taboos. The work of these combined specialist groups, along with the work of Specialist Group 9 dealing with cross border issues, is described in Section V. Specialist Group 10 continued its efforts to develop planning factors for eventual use in determining the basic serving area(s) for the new ATV service. In this regard, Section VI sets forth the work accomplished by Specialist Group 10 on (a) Planning Factors Development, (b) Definition of Spectrum Criteria, and (c) Criteria Evaluation. Finally, Section VII presents a description of the future work planned by PS/WP-3.

III. BROADCAST SUPPORT SPECTRUM (SPECIALIST GROUP 3)

A. Introduction

Specialist Group 3 (SG-3) has been assigned the responsibility of examining Broadcast Support spectrum. Included in that responsibility is an examination of the Broadcast Auxiliary Service (BAS) spectrum. This spectrum is used by television stations to convey their signals on a point-to-point basis. Uses include studio-to-transmitter links (STL's), intercity relays (ICR's), electronic news gathering (ENG) and a variety of other applications. Some of this spectrum is shared with non-broadcast users who will also require protection from interference.

Spectrum studies[1] have been conducted to determine the amount of congestion in the BAS bands and the possibility of accommodating ATV with existing broadcast support allocations. Two studies were conducted to determine the level of congestion in the television auxiliary frequency bands. One study of the top 50 market chief engineers detailed the level of usage in the STL, ENG, and ICR bands. The respondents considered all three bands (STL, ENG and ICR) to be congested, with the STL and ENG bands the most cluttered. It was found that requests for more frequencies in the three sets of bands are quite likely from many of the responding stations. In a companion survey of frequency coordinators, most respondents found the 2 GHz and the 7 GHz bands to be heavily used, with 2 GHz posing the biggest coordination problem. These studies have demonstrated the severity of the congestion facing users of auxiliary spectrum. A third study indicated that in markets below the top 30, additional STL channels for ATV could be accommodated within existing allocations.

New techniques in transmission and/or coordination must be found for more efficient use of the current BAS bands, or additional spectrum for broadcast auxiliary spectrum will have to be found with propagational characteristics similar to the present bands. Only by satisfying the auxiliary spectrum needs can the contributory and distributory requirements of

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[1] The NAB conducted these surveys, in coordination with Planning Subcommittee Working Party 3 in June, 1989.

the new ATV stations be satisfied, thus providing all existing television stations the opportunity of providing a terrestrial ATV broadcast service. Alternative media, such as fiber optics, may very well provide some relief for spectrum congestion.

B. Critical Issues

Simultaneous transmission of two signals, which may or not be identical and may or not be transmitted to or from the same site, could require substantially more capacity and thus could likely require additional support spectrum. Differences in spectrum requirements, if any, between contribution circuits and distribution circuits need to be identified. If the ATV encoder is located at the studio, then the STL must be only slightly better in performance than the transmitter that is fed by the STL. Other circuits (ICR, SEL, TSL, ENG, RPU) would be expected to be of higher quality in order to bring ATV programming to the studio from a remote location. These circuits must provide near-studio quality performance.

STL and other auxiliary spectrum circuits are critical to broadcasters. The word auxiliary is somewhat of a misnomer. There are many stations which could not exist without the STL (studio-to-transmitter link), ICR (intercity relay), TSL (transmitter-to-studio link), SEL (satellite entrance link), RPU (remote pickup) and ENG (electronic news gathering) circuits that are in daily, if not constant, use. The need for STL and other auxiliary circuits will continue to

exist and likely will expand when the Advanced Television Service begins.

The ATV video and audio signal will be encoded for broadcast either at the studio or at the transmitter site. This is a major factor affecting auxiliary spectrum needs. If the ATV signal is encoded for broadcast at the studio, the baseband bandwidth requirements for the STL will be no more than 6 MHz. Current NTSC baseband bandwidth is 4.2 MHz for video and up to 7.5 MHz (or higher) when audio and control subcarriers are added. The nature of the encoded signal (analog, multi-carrier or digital) will determine whether the protection ratios for a given STL will need to be changed from those used in current practice.

If the ATV encoder is located at the transmitter, then high definition baseband video (in some form) and related audio signals must be transmitted over the STL. This approach is likely to require much more spectrum than for NTSC.

A third possibility exists. The high definition video and audio might be digitally encoded at the studio for transmission over the STL and re-encoded into the ATV format at the transmitter for broadcast. The effects of multiple encoding and decoding, however, must be understood prior to implementing this scheme.

Enhanced NTSC signals will likely require higher performance from the existing STL than for NTSC. Enhanced NTSC signals contain more information than a standard NTSC signal. In order to transmit the extra information, more

spectrum may be needed on the STL and other microwave circuits than is currently needed for NTSC and audio subcarriers. Converting the baseband high definition video to enhanced NTSC at the studio could have a significant impact on the design of the microwave circuit.

NTSC to ATV upconversion and ATV to NTSC downconversion will take place either at the studio or at the transmitter. During the NTSC to ATV transition period, and for some time thereafter, it will be necessary to translate from one format to another. The current stock of NTSC programs and NTSC sources will have to be converted to the ATV format at some point in the chain for transmission over the ATV transmitter. Conversely, ATV programming will have to be converted to NTSC for transmission over the existing NTSC transmitter. The complexity of conversion and the kind of transmission circuit available between the converter and transmitter will determine where the converters should be located.

A new STL will be needed if the ATV transmitter is not co-sited with the existing NTSC transmitter. There will be some instances in which the ATV transmission facility cannot be collocated with the existing NTSC facility due to lack of tower space or other factors. A new STL, either microwave or fiber, will be needed to interconnect the new facility with the studio. If via fiber, no spectrum will be required. If by microwave, a new path will be needed. The collocation problem is more likely to be encountered in spectrum congested areas where additional channels in existing auxiliary service

bands are not available than in areas where there is less congestion. New spectrum coordination techniques or new spectrum will be needed to satisfy new STL requirements.

Digital compression techniques may have a major impact on the design of broadcast auxiliary circuits. The benefits of digital encoding and compression techniques of video signals are not yet fully understood. The bandwidth requirements and protection ratios may change substantially. Digital modulation is less susceptible to interference than analog modulation. Furthermore, even the use of high performance multi-phase digital modulation permits the reconstruction of the original signal.

C. Questionnaire

A letter was recently sent to the ATV proponents seeking information that will help to identify ATV non-broadcast spectrum requirements from the systems point of view. Decisions regarding individual subsystems need to be made in light of all other aspects, such that the complete system preserves the signal integrity in an efficient, cost-effective and pragmatic manner. Microwave communications are just one of the many subsystems that need to be considered.

A complete systems approach requires the understanding of all elements in that system. Several questions were sent to the proponents and need to be addressed to achieve that understanding. These questions are described briefly below. The results of this questionnaire will be incorporated into the future work of Specialist Group 3.

1. Can the transmission/compression format the proponent is proposing as a broadcast standard be transmitted over a point-to-point microwave channel, or must it be modified? If modified, in what way?

Some of these channels, known as "Contribution Circuits," are intended to handle signals that will be mixed into program material downstream, such as those from another studio. The performance requirements are generally the highest of any microwave channels. While the definition of these Circuits will vary among situations, in every case the intent would be to allow the mixing of video signals from outside a particular studio with signals within that plant. Examples would include the option of performing digital video effects between these two sources.

Other channels carry signals not intended to be added to other program sources, but rather feed distribution networks such as terrestrial transmitters. One principal example would be a broadcast station's studio-to-transmitter link (STL). These channels are known as "Distribution Circuits."

There are many situations where the intended use of the signal may change, thus changing the definition of the Circuit. NTSC allows this change without a change in signal format since the NTSC signal format is employed in both types of circuits. The possibility now exists that multiple formats will be required to avoid the concatenation of conversion processes and thus preserve the signal integrity. Preservation of bandwidth is also of utmost concern.

2. Can the transmission and compression format the proponent is proposing as a broadcast standard serve for both Contribution Circuits and Distribution Circuits? If it cannot serve for Contribution Circuits, what format should be proposed for Contribution Circuits? Would more than one signal path be needed in parallel to provide a complete Circuit? (i.e., component signals, such as R/G/B or $Y/P_r/P_b$, or split composite signals are proposed to be sent).

   (See Appendix A for Microwave Technical Specifications)

3. What bandwidth(s) would be required for the proponents' Contribution Circuits and Distribution Circuits over microwave? Would the modulation of each Circuit type used be FM or another form?

   (See Appendix B for the Electrical Performance of NTSC Microwave Links)

4. The proponents were also asked to provide a list of performance requirements that might be analogous to the ANSI/TIA/EIA-250-C requirements, modified appropriately for their signal format. If this is different for Contribution and Distribution Circuits, both sets of requirements would have to be provided.

D. A Study of Auxiliary STL Spectrum Space

In order to explore the impact of ATS on broadcast support spectrum in markets below the top 30, a study was done of frequency coordination in the state of North Carolina assessing the availability of 7-GHz broadcast auxiliary microwave spectrum space. The intent of this study was to determine the possibility of providing a second STL channel (6 MHz of baseband) within the current 7-GHz Broadcast Auxiliary Band for ATV STL's. It was concluded, as described in more detail below, that an additional STL channel to carry the ATV signal could probably be made available to each North Carolina broadcaster from existing spectrum allocations, but the

installation of high performance microwave antennas on affected co-channel links is likely to be required.

The four largest television markets (DMA) in North Carolina are Charlotte #31, Raleigh/Durham #33, Greensboro/ Winston-Salem #49, and Asheville/Greenville/Spartanburg #35. In addition, there are two other smaller markets: Wilmington #145, and Greenville/Washington/New Bern #104.

Most television stations in North Carolina operate at 7 GHz. STL/ICR's typically use standard performance 6-foot microwave antennas similar to Andrew P6-65 (FCC Category B), or standard 8-foot antennas similar to Andrew P8-65. Only one broadcaster in North Carolina is using high performance antennas similar to Andrew HP8-65E. This type of antenna exhibits greatly improved side-lobe rejection compared to standard parabolic antennas.

Preliminary findings have indicated that in most areas of North Carolina, it would be possible to assign a second STL channel from existing allocations for ATV. However, this assignment would almost always require a change to antennas with narrower beam widths and diminished side lobes, and coordination of antenna polarization. In some cases additional filtering may be required, such as 20-MHz IF filters and 25-MHz RF filters.

The critical limiting factors are the angles and distances of each microwave installation relative to those of other users. It is difficult to coordinate additional microwave channels to broadcasters operating in similar

locations, where relative path angles between systems are small.

The NAB Television Auxiliary Frequency Usage Survey revealed high levels of congestion in the 7 GHz microwave band, but did not specifically ask if additional capacity would be possible by re-engineering microwave paths. Other states similar to North Carolina in population density and area would find, in many cases, that BAS spectrum is available for extra STL channels if microwave paths were carefully engineered.

Additional STL and other auxiliary spectrum will be needed in many areas of the country. It is certain that the top 30 markets will need additional microwave spectrum for ATV STL's. The amount of additional spectrum required is dependent upon the degree of efficient use of the spectrum and the utilization of alternate technologies for interconnection such as fiber.

E. Possible New Spectrum For ATV Broadcast-Support

The rapid strides being made with respect to new technology such as video compression, fiber optics, and with respect to improvements in microwave equipment and techniques cannot be disputed. But it has become obvious that some additional spectrum will be needed, primarily in major markets -- at least for the short terms -- to meet the requirements for ATV broadcast-support spectrum. The purpose of this section is to review the spectrum considerations involved and to suggest possible segments of the microwave spectrum that